Science Collaborative Progress Report for the Period 09/01/12 through 02/28/13

Project Title: Determining the role of estuarine 'swashes' on water quality impairment along the Grand Strand of South Carolina: Impacts of land use and stormwater runoff.
Principal Investigator(s): Dr. Erik M. Smith
Project start date: September 15, 2010
Report compiled by: Dr. Erik M. Smith
Contributing team members and their role in the project:
M. Richard DeVoe – Integration Co-lead
Dr. Denise M. Sanger – Integration Co-lead
Leigh Wood – Local Outreach Facilitation
Dr. Susan Libes – Research Co-PI
Dr. Richard Viso – Research Co-PI
Dr. Richard Peterson – Research Co-PI
Dr. Jennifer Plunket – Research Co-PI

A. Progress overview: The overall project goal is to address how land use attributes and stormwater management practices and conveyance within swash watersheds affect nutrient and organic matter loading to those swashes, their internal transformations, and subsequent export to the coastal ocean. The ultimate intent is to enable effective management strategies, based on sound science, that improve and protect coastal water quality, particularly with respect to hypoxia, in Long Bay. To do so, the following key project objectives have been identified: 1) Work with intended users to define and develop a categorization scheme for all 14 swashes and select 4 swashes for intensive investigation during the proposed study; 2) Quantify concentrations and forms of nutrient and organic matter entering swashes via surface water and groundwater inputs; 3) Determine internal conditions and processes affecting organic matter transport and transformations in swashes; 4) Quantify the form and net tidal export of nutrients and organic matter from swashes; 5) Engage intended users to enable use of data to collaboratively develop science-based cost-effective management strategies.

During this reporting period all planned progress on achieving Objectives 2, 3 and 4 was accomplished. Since the last project workshop between researchers and intended users resulted in a collective decision to maintain sampling efforts in the Year 1 study sites, rather than switching the research to two new swashes (as detailed in our previous progress report), data collection and sample processing for the two Year 1 study swashes continued as planned and is currently ongoing.

B. Working with Intended Users: Maintaining a strong relationship with participating municipalities is a key success component to the NERRS Science Collaborative Swash Project, especially since the results are intended to eventually help inform planning and engineering solutions. Since the beginning of the project, local decision-makers, coastal resource managers, and researchers have been brought together to help define the problem and assist with project implementation.

During this reporting period, the Coastal Training Program, in conjunction with the Coastal Waccamaw Stormwater Education Consortium and the City of Myrtle Beach, hosted an interpretive tour of the Withers Swash Watershed on November 15, 2012. This 2-hour program held at Myrtle Beach City Hall included presentations and brief talks from a variety of researchers performing water quality research, restoration, and monitoring in the watershed, including the NERRS Science Collaborative Swash project. The workshop initiated with an overview presentation on hypoxia in Long Bay, which was presented by NI-WB Research

Coordinator, Dr. Erik Smith. Presentations were followed by a shuttle tour navigating through parts of the watershed and informing the participants about the various research and monitoring projects occurring within it. During this tour Dr. Susan Libes of the Waccamaw Watershed Academy addressed water quality monitoring occurring at 2nd Avenue Pier, Dr. Keith Walters of Coastal Carolina University discussed a community-based oyster restoration project occurring in the watershed and Dr. Erik Smith discussed the research associated with the NERRS Science Collaborative project. Additionally, municipal staff addressed their efforts to improve local water quality through land use planning, stormwater management, and genotypic source tracking.

Over 25 people involved in water quality protection and land use decision-making, including stormwater managers, municipal officials, community leaders, water quality educators, and interested researchers, attended the program. The tour served as an ideal opportunity to bring multiple jurisdictions and resource managers to the table to discuss the hydrology of the watershed, water quality concerns, and local research and management efforts that are collectively informing and working to minimize the impacts of development and stormwater on our coastal waters. The program proved to be successful despite the inclement weather that occurred on the day of the tour; water quality researchers and managers were still able to interact and share knowledge with local government staff and officials.

Engagement to date has not brought about any unanticipated challenges, but it has informed the project team of the varying education and training needs of the local communities. The project team recommends that the Coastal Training Program and the Coastal Waccamaw Stormwater Education Consortium continue to engage local decision-makers and business leaders on the outcomes of the research and monitoring occurring in Withers Swash Watershed, as there are many efforts simultaneously occurring in this impaired basin.

At this point there is little anticipated need to work with intended users in the next six months, since the project is fully up and running with a current focus on data collection.

C. Progress on project objectives for this reporting period:
The following five key project objectives were identified for the project: 1) Work with intended users to define and develop a categorization scheme for all 14 swashes and select 4 swashes for intensive investigation during the proposed study; 2) Quantify concentrations and forms of nutrient and organic matter entering swashes via surface water and groundwater inputs; 3) Determine internal conditions and processes affecting organic matter transport and transformations in swashes; 4) Quantify the form and net tidal export of nutrients and organic matter from swashes; 5) Engage intended users to enable use of data to collaboratively develop science-based cost-effective management strategies.

The first objective was accomplished as proposed during the previous reporting period. The second, third and fourth objectives are all related to sampling the inputs, internal processes and outputs from the swashes. Through the end of the current reporting period, a total of 26 sampling events have been conducted between the two study swashes (Table 1). Estimates of water discharge (via ADCP measurements in Withers and water level over spillway in Dogwood) and swash water temperature, conductivity, dissolved oxygen, turbidity and chlorophyll fluorescence (via YSI sonde deployment) have been made semi-continuously throughout this period. On each sampling event, grab samples were collected (via ISCO automated samplers) for concentrations of nitrogen and phosphorus (in all forms), dissolved organic carbon, particulate organic carbon, total suspended sediments, and chlorophyll *a* were made in surface waters of each of the upstream sampling stations as well as in the main swash body. On each sampling event, ground water samples were collected for concentrations of dissolved nitrogen

and phosphorus (in all forms), and dissolved organic carbon, at each of the upstream sampling stations as well as at the main swash body discharge site. Nearly continuous measurements of Rn-222 were made in surface waters at both the Wither and Dogwood swash mouth sites, while discreet grab-samples for Rn-222 were collected from groundwater wells at mouth and each upstream site during dry and wet sampling events. In addition, weekly grab sample of surface waters for Rn-222 at each upstream site were collected. Measurements of water column primary production and community respiration were also made in the main swash body. Rainfall amounts and storm hydrographs were collected at each of the upstream events during each rain event sampling. Analytical processing for all of the above sampling is currently in progress. In addition, during this reporting period we began making periodic manual water velocity measurements at all upstream sampling stations with a hand-held Sontek Flowtracker. This will overcome the discovered limitations of the in situ ISCO flow meters in accurately quantifying water velocity at the low flows experienced in these systems. Since the ISCO flow meters are doing an good job measuring water level, but a poor job resolving flow rates, we now intend to develop empirical relationships between level and water velocity (from Flowtracker measurements) at each upstream station to use in determining total water discharge and nutrient/organic matter fluxes.

During this reporting period we were also able to finalize delineations of swash watersheds and sub-basins and quantify their land use / land cover. This was done working collaboratively with key intended users from Horry County and Myrtle Beach.

The fifth objective is a continuing process which will evolve throughout the project. The interactions discussed above with the Intended Users and other audiences are all important steps toward this objective.

Plans for meeting project objectives for the next six months entail continued sample collection and processing, as outlined above.

D. Benefit to NERRS and NOAA: None during the current reporting period.

E. Other: The NI-WB NERR recently began a collaboration with Hach/SeaBird Scientific to field-test a variety of in situ sensors for application in shallow-water coastal monitoring. As a result, we were able to install a new instrument package at the Withers Swash mouth sampling site that consists of a WET Labs Cycle-P in situ phosphate analyzer, a Satlantic SUNA optical nitrate sensor and a WET Labs chlorophyll, fDOM and turbidity fluorometry package. This equipment allows phosphate and nitrate concentrations to be estimated continuously at hourly intervals and chlorophyll, turbidity and fDOM concentrations to be estimated continuously at 15 minute intervals. The equipment was installed in early February with plans to maintain the installation through the end of this project. While the data quality and robustness of the instrumentation are still being evaluated, if the instruments perform as expected this will allow us the ability to collect time-series of key nutrient parameters at unprecedented frequencies. This will be a significant enhancement to this project in that it will greatly improving our ability to quantify the form and net tidal export of nutrients and organic matter from Withers swash. The successful demonstration of this instrumentation for shallow water applications should also be of broader interest to the NERRS and NOAA.

Table 1. Sampling events for each swash by type of event through the current reporting period.

SWASH	Event Type	Event Dates	Event #
Withers	Dry	July 7-8, 2011	1
Withers	Rain	July 24-25, 2011	2
Dogwood	Rain	August 13-14, 2011	3
Dogwood	Dry	September 13-14, 2011	4
Withers	Dry	October 4-5, 2011	5
Withers	Rain	October 10-11, 2011	6
Dogwood	Rain	November 16-17, 2011	7
Dogwood	Dry	December 11-12, 2011	8
Withers	Dry	January 2-3, 2012	9
Withers	Rain	January 11-12, 2012	10
Dogwood	Dry	January 31, 2012-February 1, 2012	11
Dogwood	Rain	February 18-19, 2012	12
Withers	Rain	March 24-25, 2012	13
Withers	Dry	April 11-12, 2012	14
Dogwood	Dry	May 1-2, 2012	15
Dogwood	Rain	May 9-10, 2012	16
Withers	Rain	May 30-31, 2012	17
Withers	Dry	June 25-26, 2012	18
Dogwood	Dry	July 16-17, 2012	19
Dogwood	Rain	August 7-8, 2012	20
Withers	Rain	August 28-29, 2012	21
Withers	Dry	September 23-24, 2012	22
Dogwood	Dry	October 17-18, 2012	23
Dogwood	Rain	November 15-16, 2012	24
Withers	Dry	January 6-7, 2013	25
Withers	Rain	February 7-8, 2013	26